Determination of Ground Water Protection Areas and How They are Used

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Mandate for Monitoring and Regulation

- 1985 - Pesticide Contamination Prevention Act was Enacted requiring DPR (CDFA then):
  1. Maintain data base for statewide well sampling and respond to reported detections
  2. Sample for pesticides with potential to move to ground water
  3. Review/regulate detected pesticides
     - Part of regulation is modifying use of detected pesticides in vulnerable areas

CALifornia VULnerability Approach

- CALVUL is an empirical approach - driven by well sampling data and based on detections
- GWPAs identify vulnerable areas – vulnerable areas based on soil conditions and depth to ground water
- Mitigation matched to GWPA condition – Combination of soil properties and anthropogenic activities define pathway of water to ground water and subsequent mitigation measures

United States System of Surveying the Public Lands
Public Lands Survey (PLS)

USGS stores geographic information on topographic maps

Section of Land = 1 Square mile area of land = 640 acres (US)

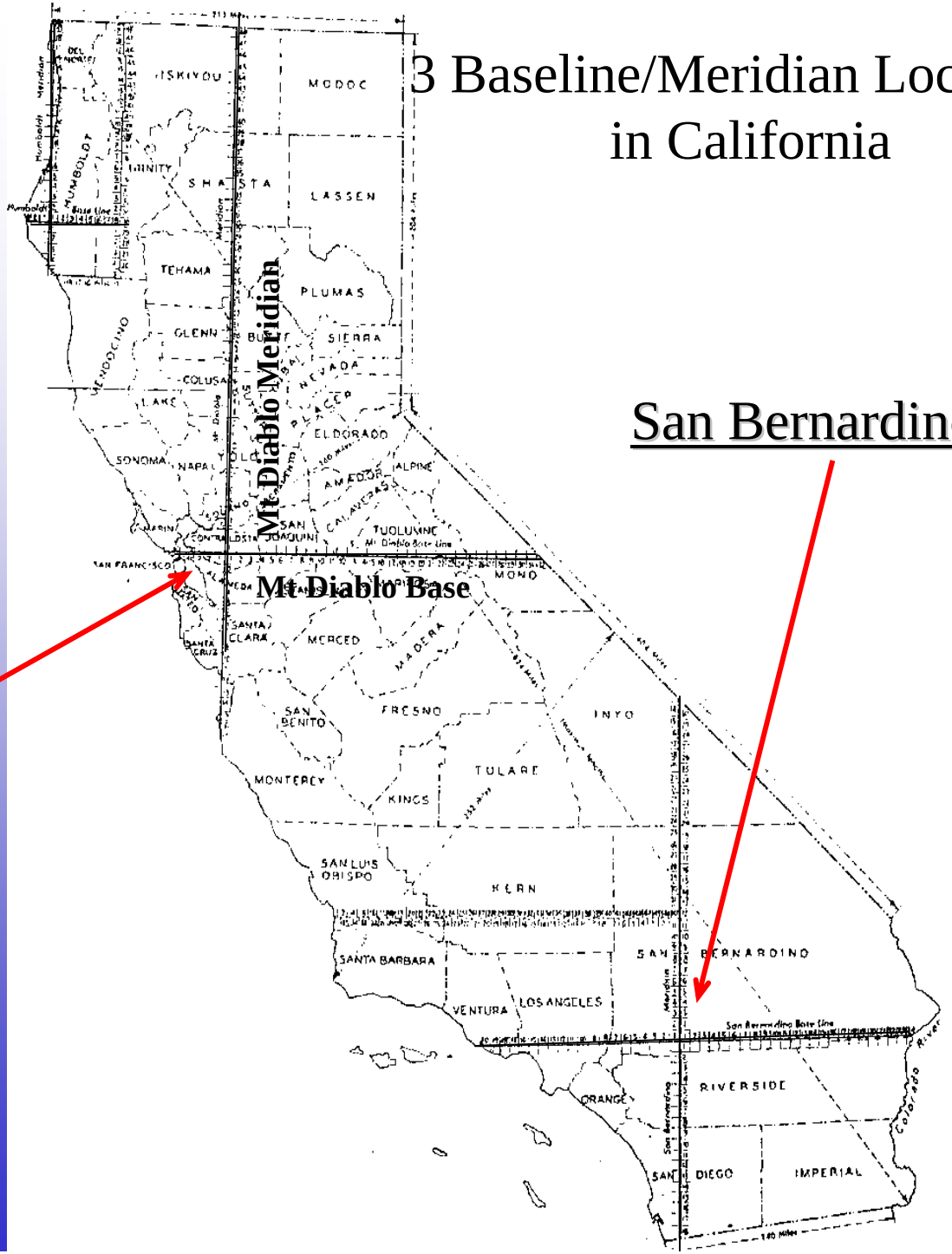
Township/Range = 6x6 square of sections of land = 36 sq. miles

One T/R With Section Numbers

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

3 Baseline/Meridian Locations in California

Humboldt



San Bernardino

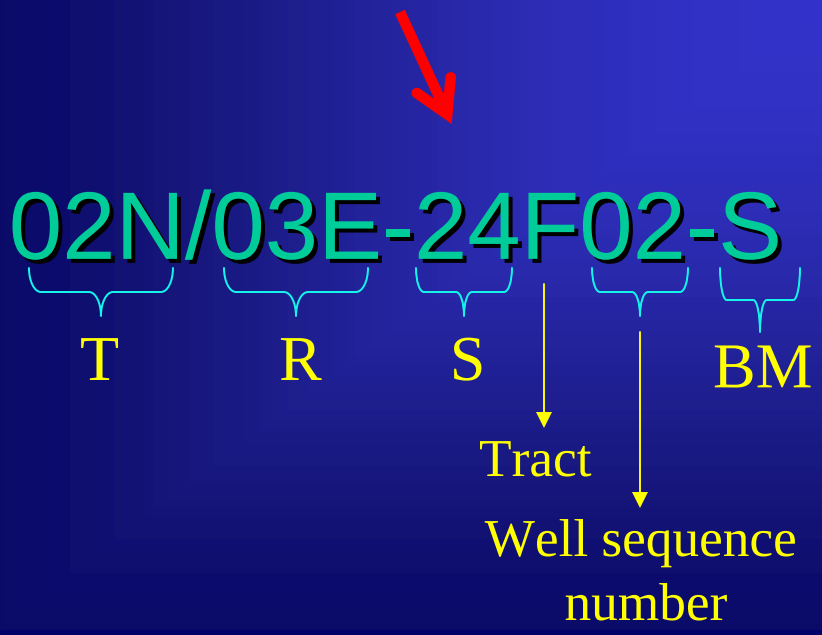
Mt. Diablo

Well Numbering Example

Section Broken Down Further in to 16 tracts

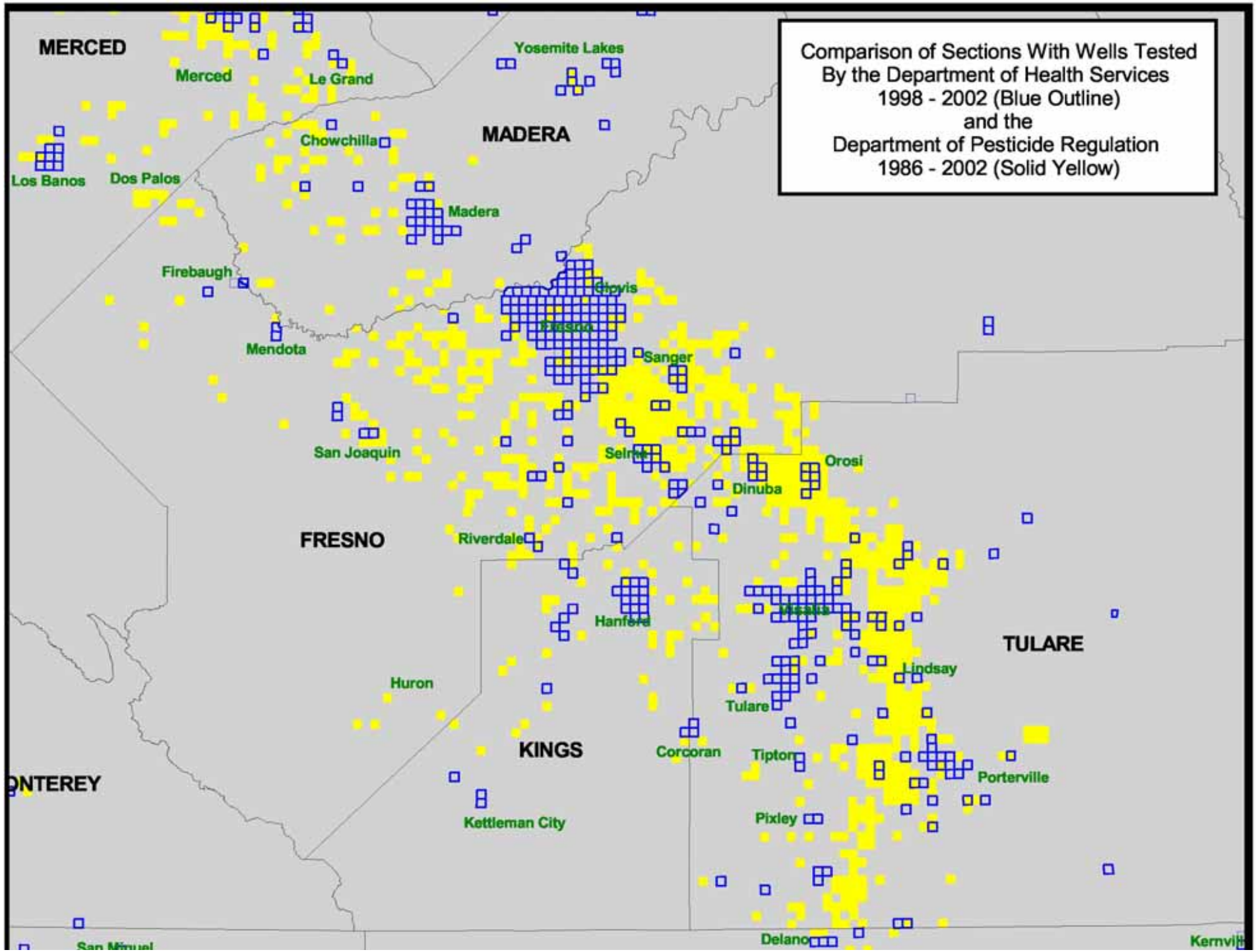
Tract = 40 acres

- Letters used
- Serpentine assignment
- No I or 0 used
- Wells numbered sequentially

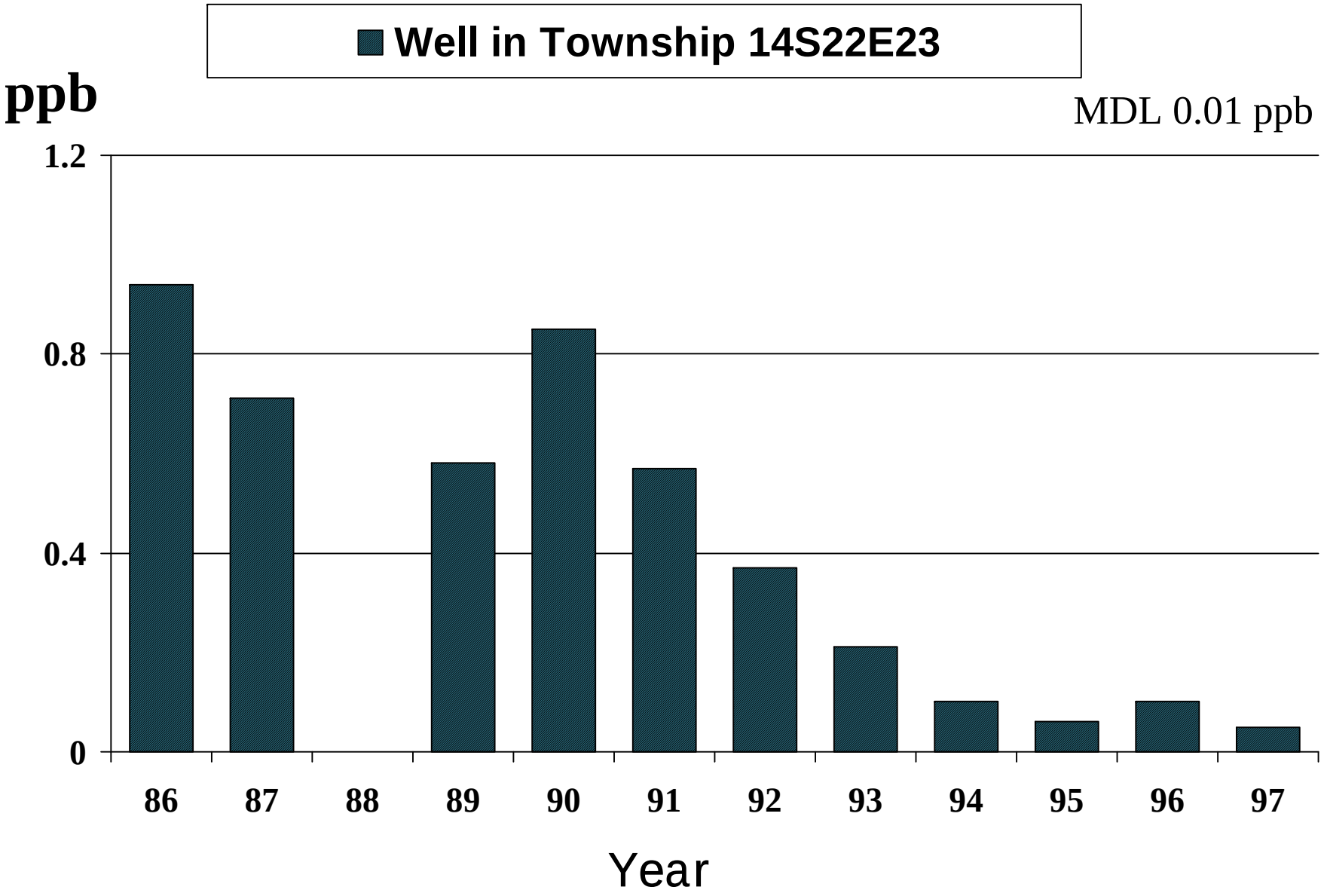


Tract Letter Assignment

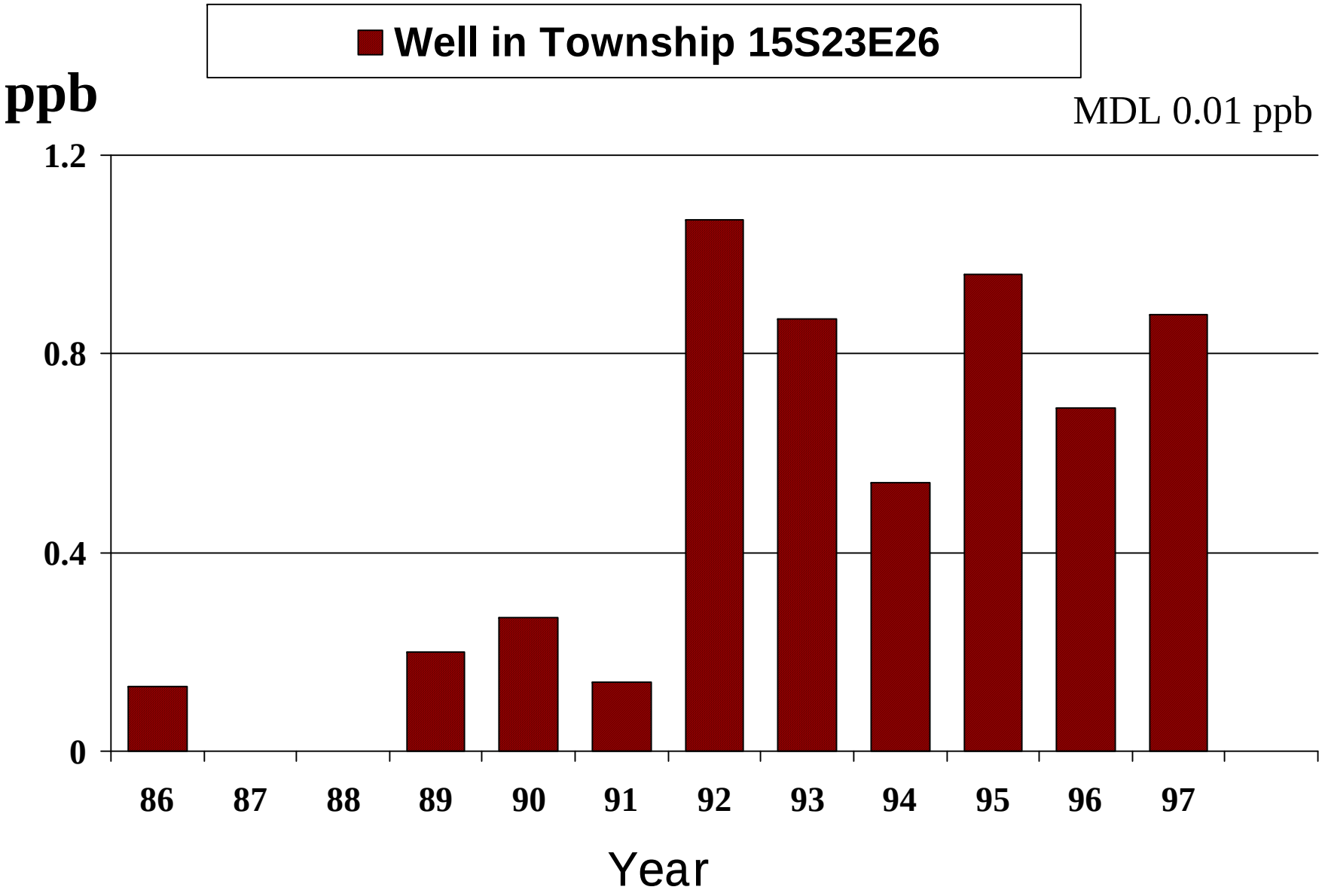
D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

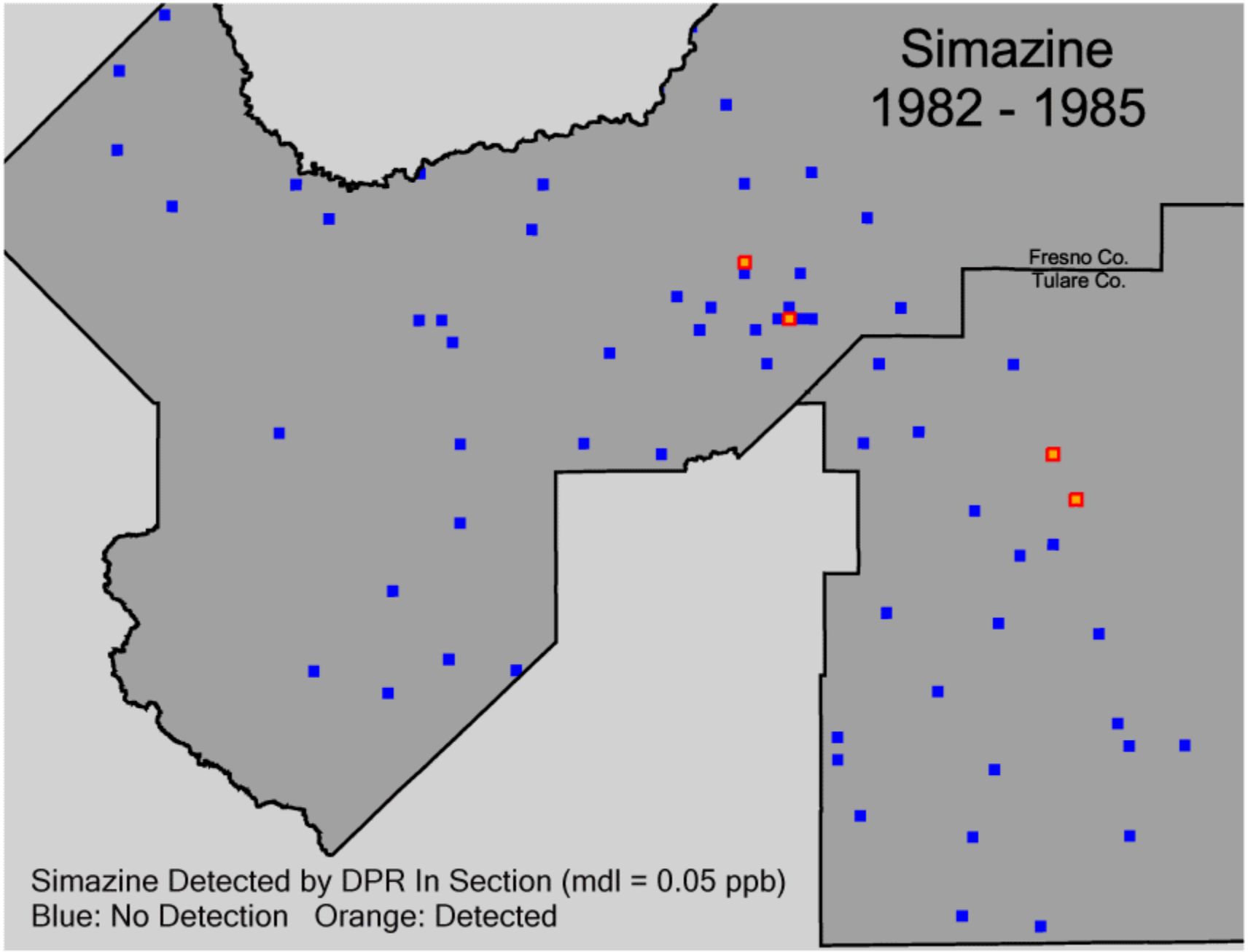

Comparison of Sections With Wells Tested
By the Department of Health Services
1998 - 2002 (Blue Outline)
and the
Department of Pesticide Regulation
1986 - 2002 (Solid Yellow)
MERCED
Merced
Le Grand
Yosemite Lakes
MADERA
Chowchilla
Los Banos
Dos Palos
Madera
Firebaugh
Mendota
Clovis
Fresno
Sanger
San Joaquin
Selma
Orosi
Dinuba
FRESNO
Riverdale
Hanford
Visalia
TULARE
Lindsay
Huron
Tulare
KINGS
Corcoran
Tipton
Porterville
Pixley
Kettleman City
Delano

DBCP in Wells Sampled after Suspension in 1979



DBCP in 3 Wells Sampled after Suspension in 1979



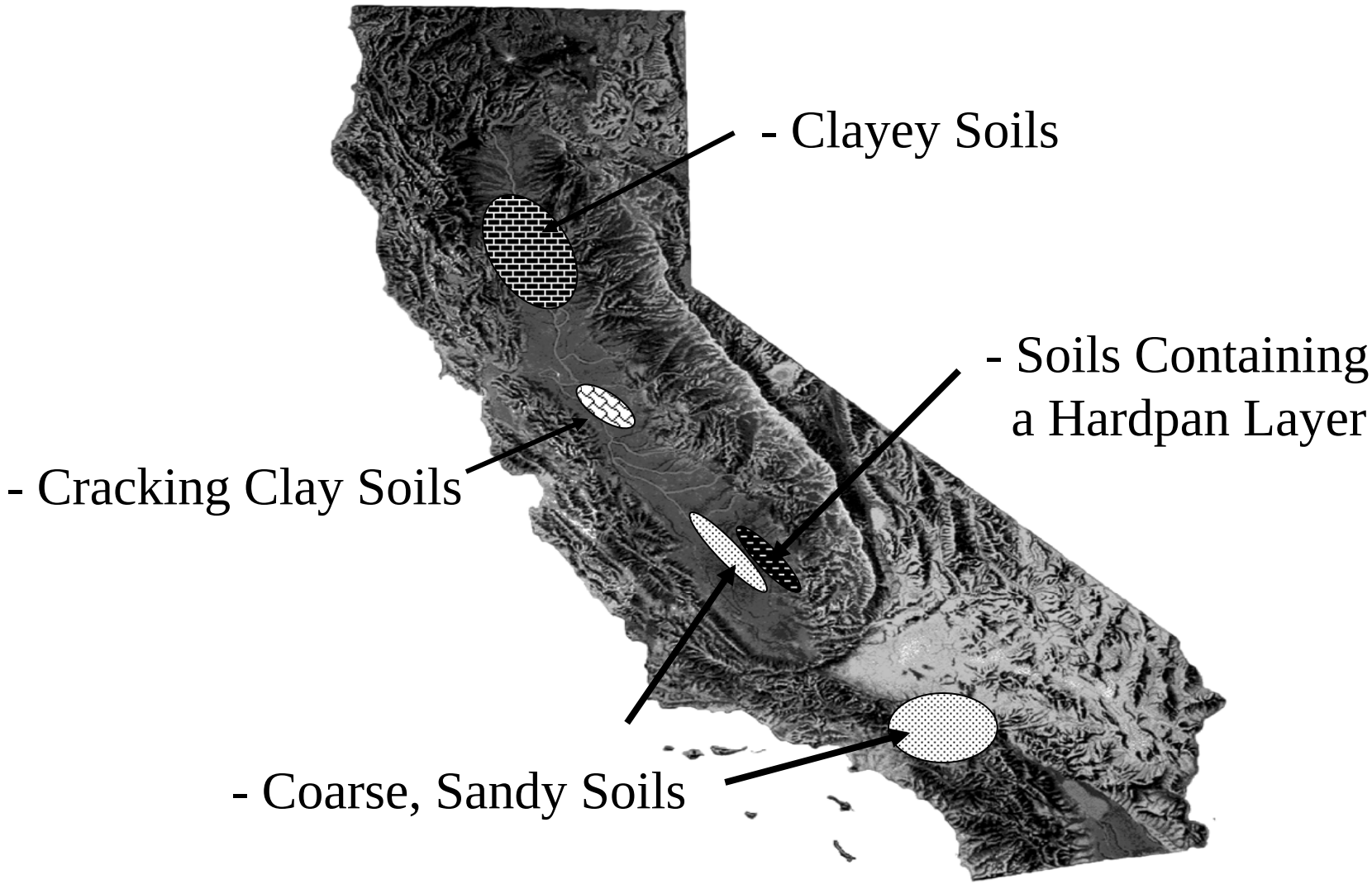

Simazine
1982 - 1985
Fresno Co.
Tulare Co.
Simazine Detected by DPR In Section (mdl = 0.05 ppb)
Blue: No Detection Orange: Detected

Defining Vulnerable Areas

Characteristics of Vulnerable Areas

- ✓ **Soil Characteristics**

Major Soil Conditions in California of Areas with Pesticide Detections



Approach to Define Vulnerability

- Developed a data base of detections in varied geographic conditions

- Vulnerable section identified as detection of residue in well water due to non-point source

- Enabled use of clustering methodology for developing a spatial vulnerability assessment

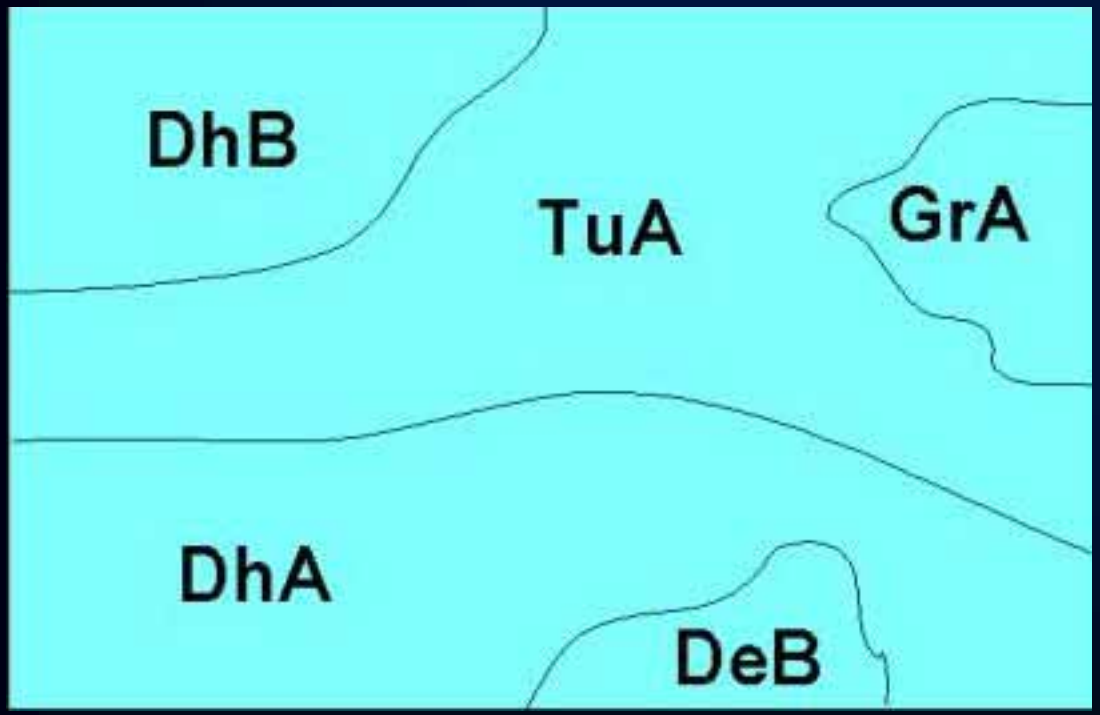
- Asked question:

  Are there common soil characteristics between vulnerable sections?

Soils Data Base for Sections of Land

CSMUID database developed that listed all soil MUIDs in a section of land. Data taken from maps in printed surveys

Township/Range/Section: 20N1803



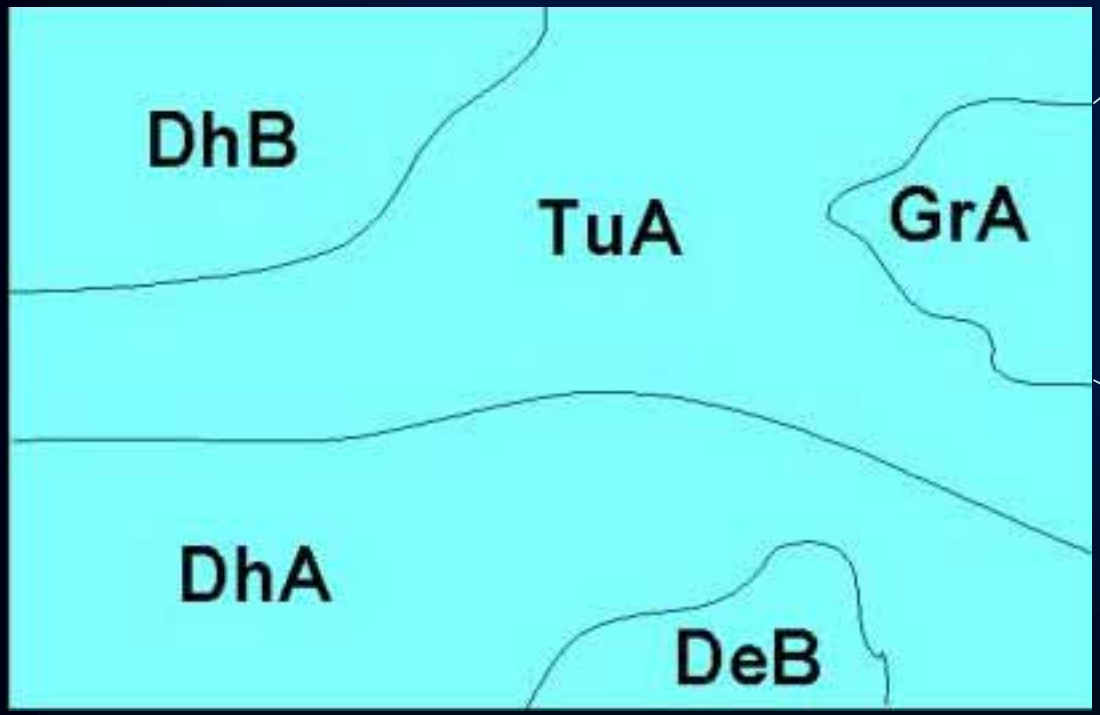
CSMUID

20N1803 GrA
20N1803 TuA
20N1803 DhA
20N1803 DhB
20N1803 GRA

Data Extracted from NRCS Tables

1. Composition table contains descriptive data for entire soil

Township/Range/Section: 20N1803



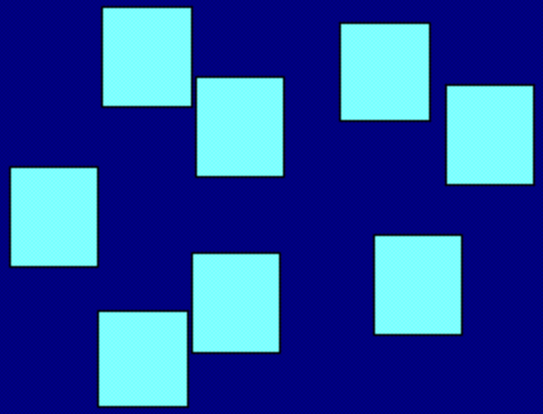
GRA Comp Table

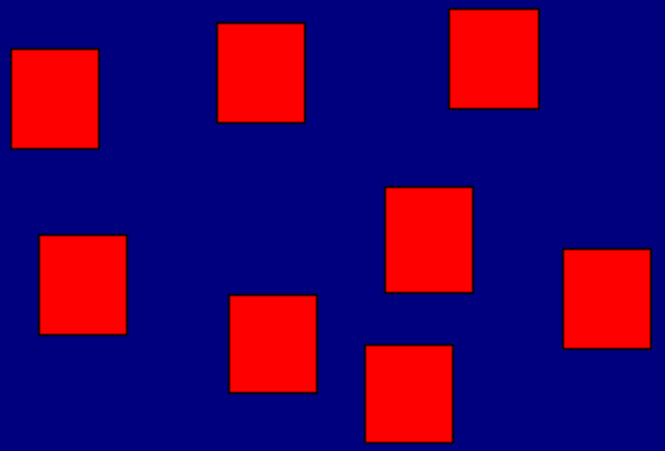
Variables
Texture
Hardpan
Water table
Hydrologic group
Slope
Flooding

Coarse-Textured

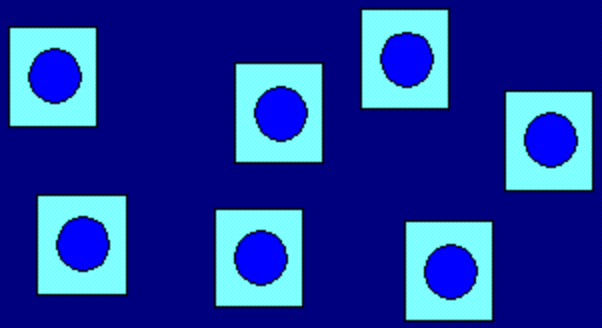
Fine-Textured

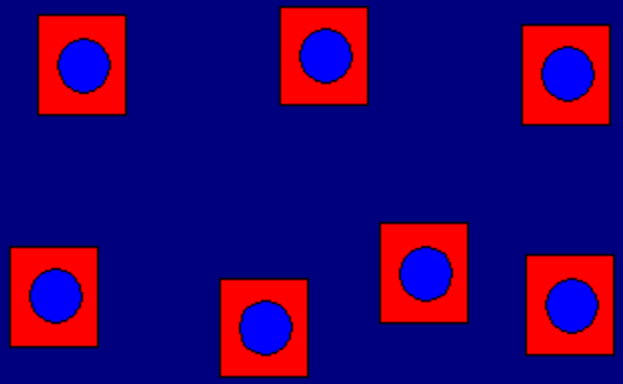
NO HARDPAN



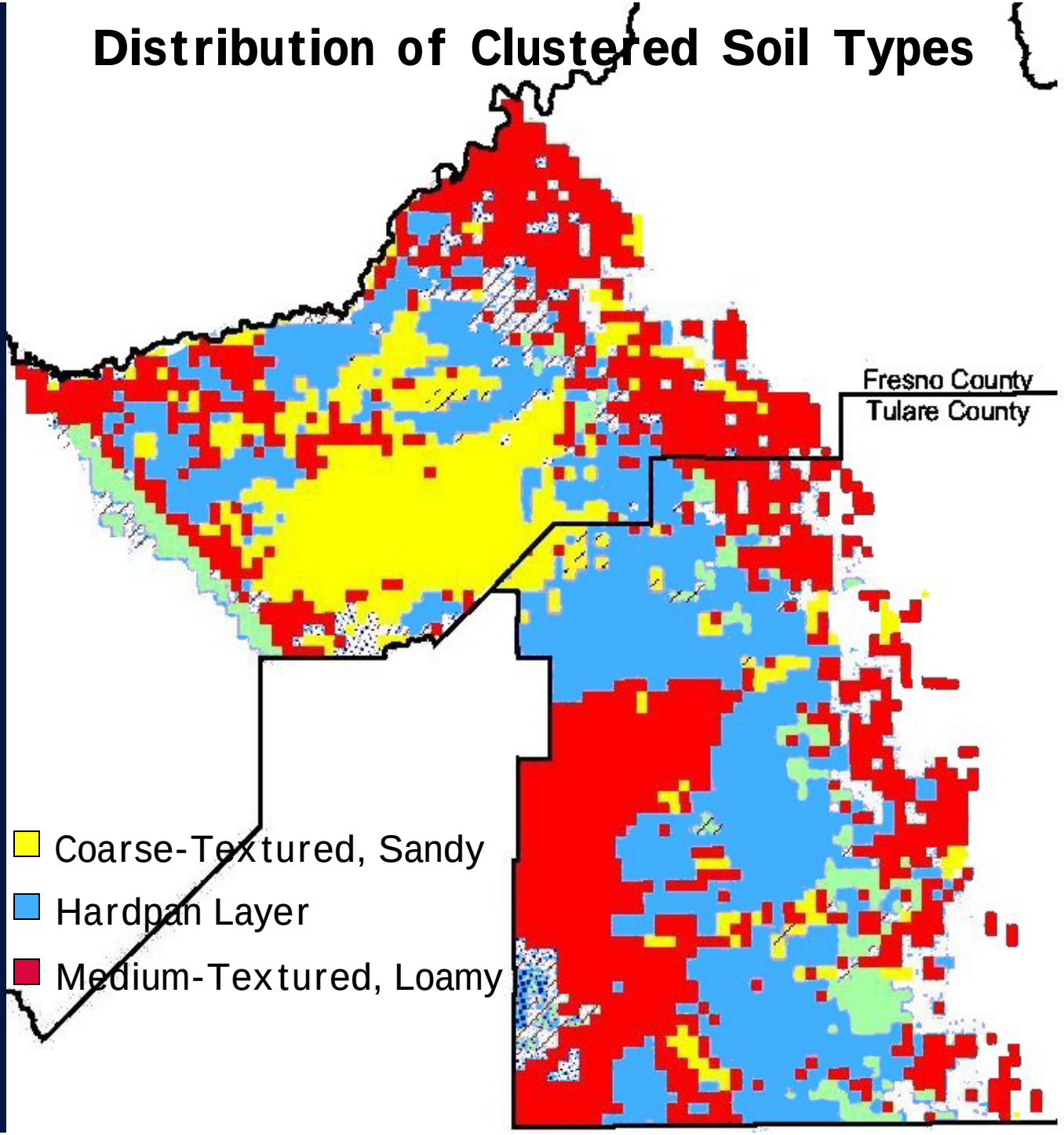


HARDPAN





Distribution of Clustered Soil Types

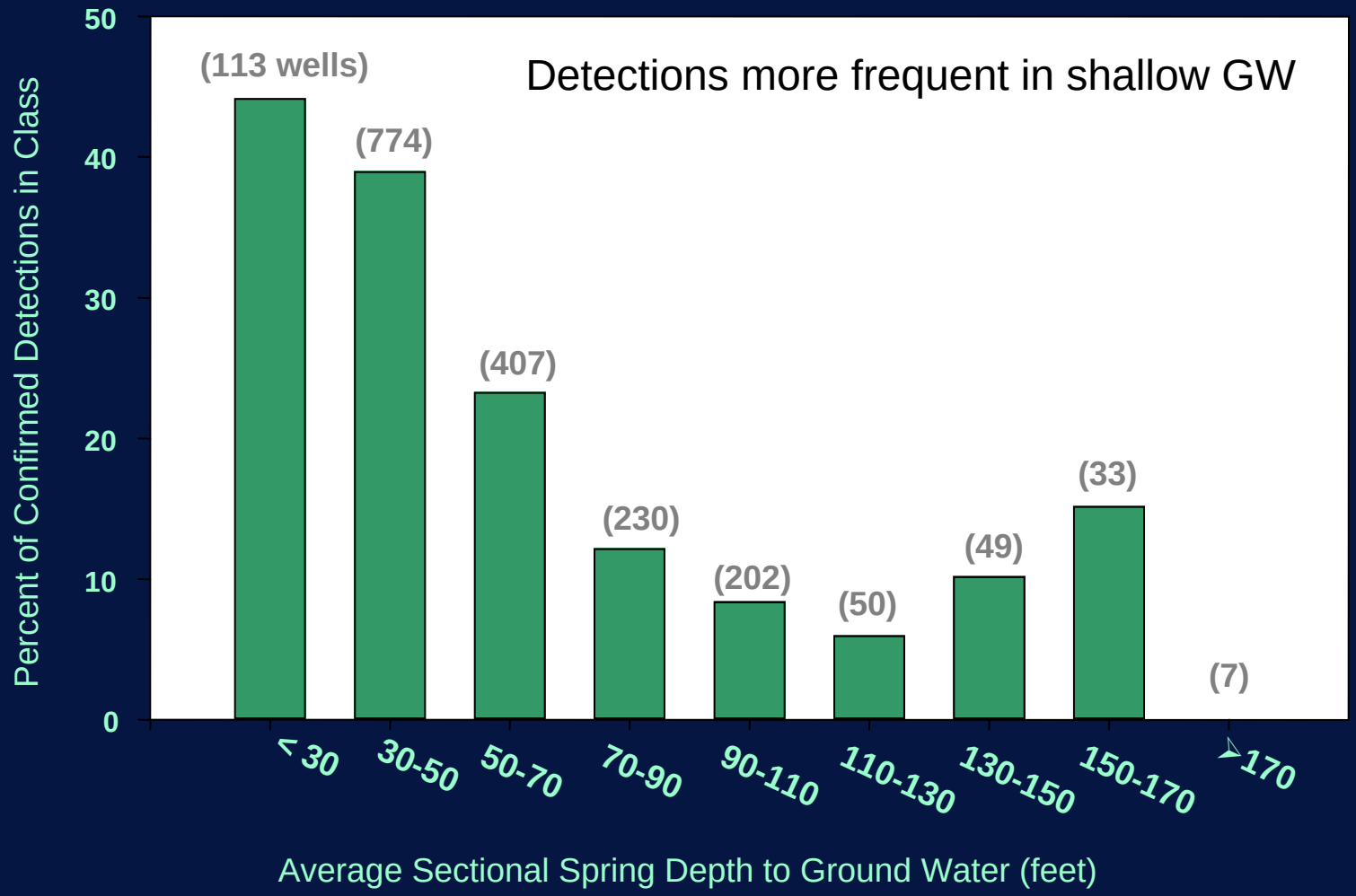


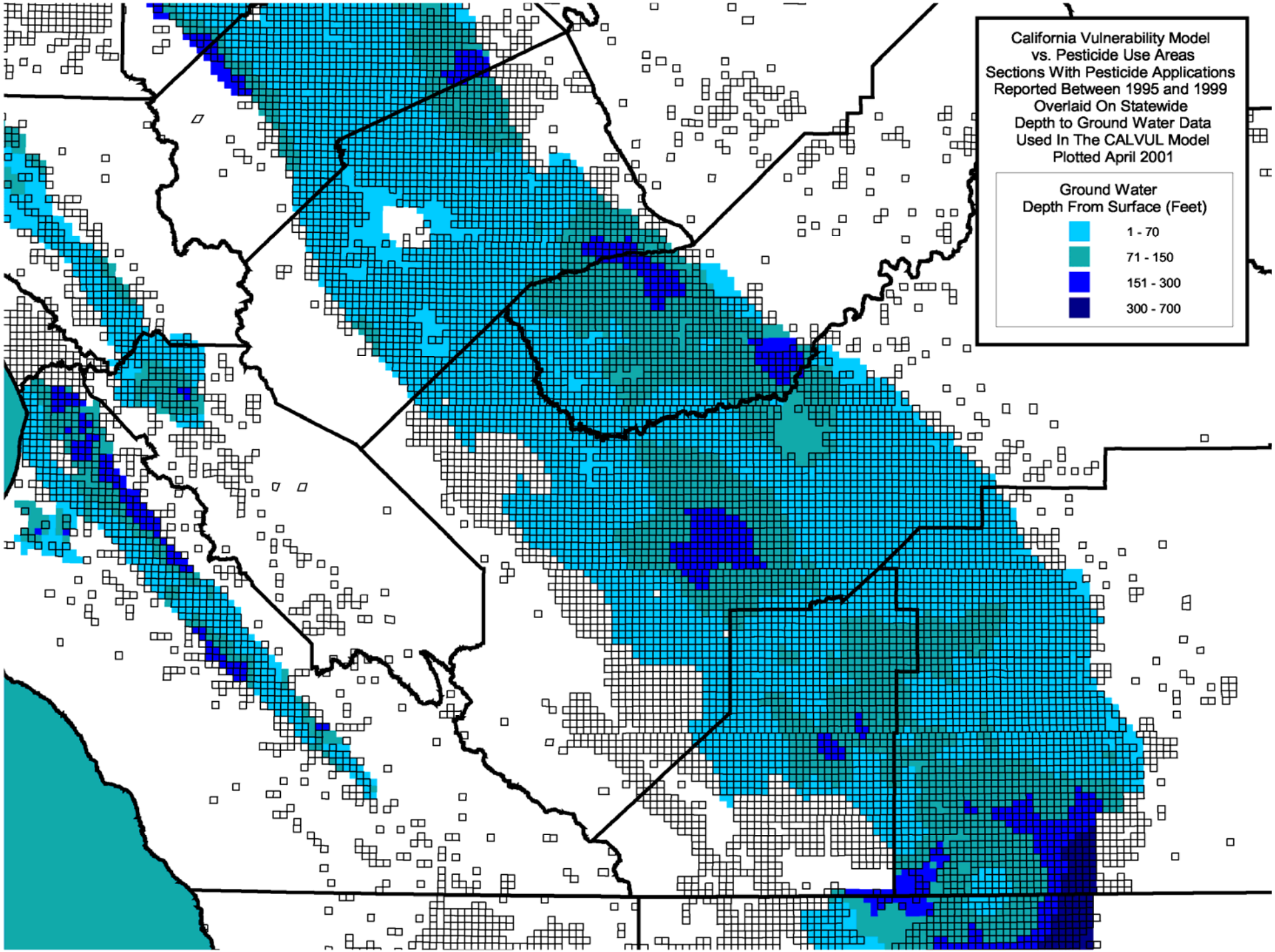
Defining Vulnerable Areas

Characteristics of Vulnerable Areas

- ✓ Soil Characteristics
- ✓ Depth to Ground Water

Frequency of pesticide detections in wells in relation to average depth- to-groundwater for sections Fresno and Tulare Counties.




California Vulnerability Model
vs. Pesticide Use Areas
Sections With Pesticide Applications
Reported Between 1995 and 1999
Overlaid On Statewide
Depth to Ground Water Data
Used In The CALVUL Model
Plotted April 2001
Ground Water
Depth From Surface (Feet)
1 - 70
71 - 150
151 - 300
300 - 700

Ground Water Protection Area

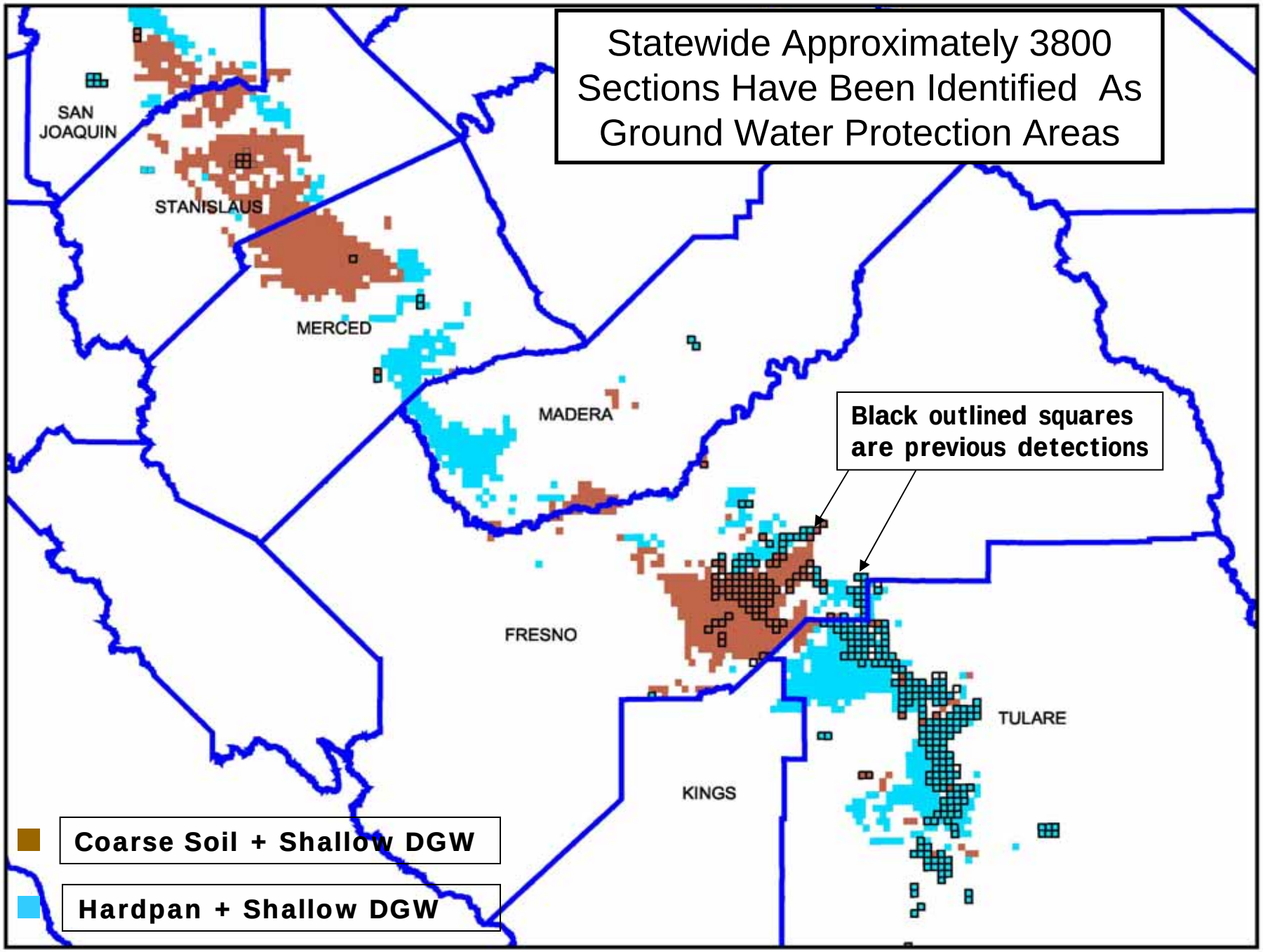
Section of Land with Vulnerable Soil Condition

+

Shallow Depth to Ground Water

+

Known Pathway to Ground Water

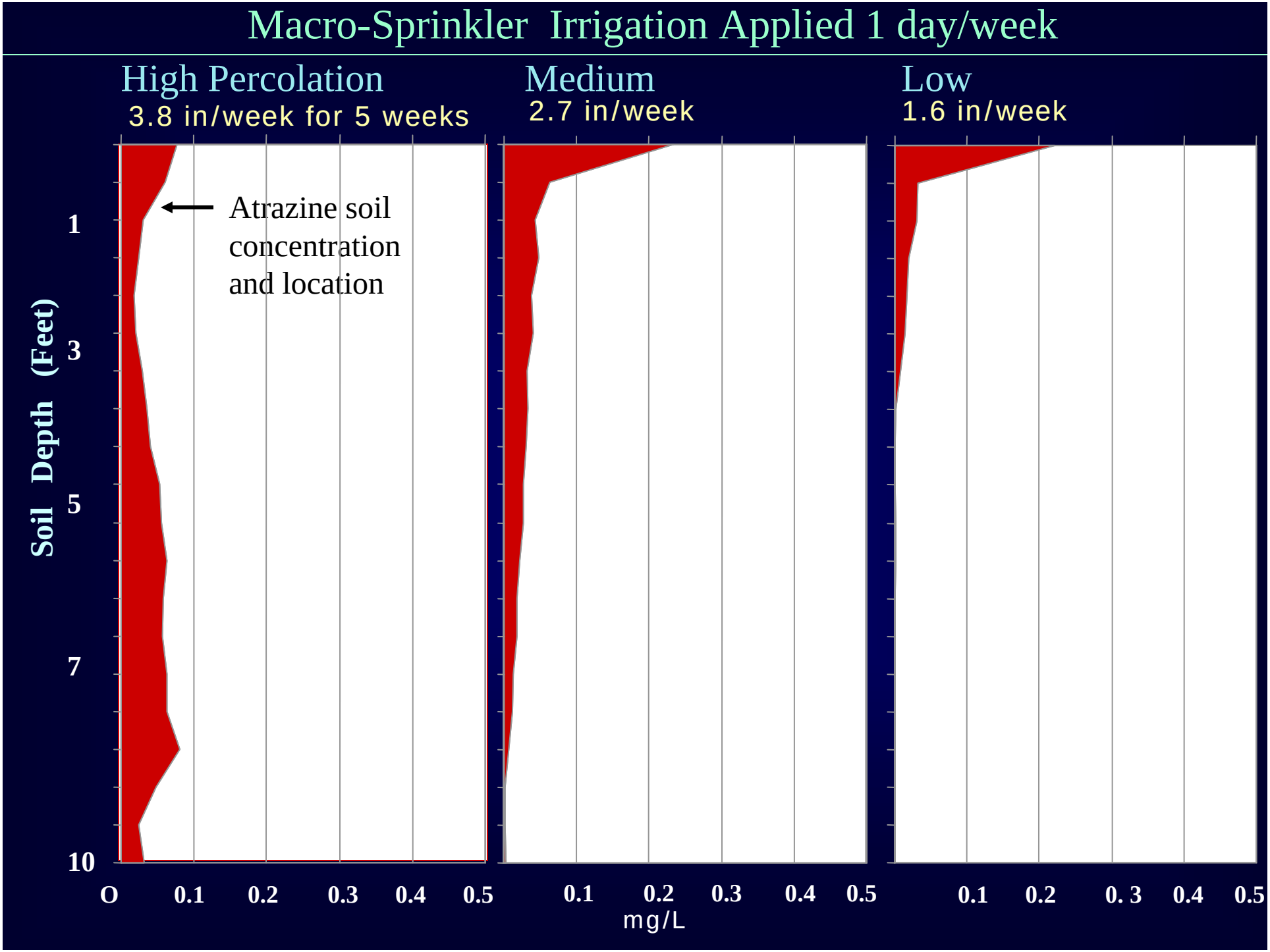

Statewide Approximately 3800 Sections Have Been Identified As Ground Water Protection Areas
SAN JOAQUIN
STANISLAUS
MERCED
MADERA
FRESNO
KINGS
TULARE
Black outlined squares are previous detections
Coarse Soil + Shallow DGW
Hardpan + Shallow DGW

Use of Ground Water Protection Areas

- Identify areas that require greater regulation for protection of ground water resources

- Implement management practices associated with the pathway of movement to ground water

Determinant Soil Property	Pathway and Control
Coarse, Sandy Soil – Soils with High Infiltration rates	Leaching with surface water that percolates To ground water Minimize Percolation
Finer-textured Or Hardpan Present – Soils with Low Infiltration Rates	Residues move offsite in runoff water to sensitive sites Improved Incorporation i.e. not by rainfall *Or* Manage Runoff Water


Macro-Sprinkler Irrigation Applied 1 day/week
High Percolation
3.8 in/week for 5 weeks
Medium
2.7 in/week
Low
1.6 in/week
Atrazine soil concentration and location
Soil Depth (Feet)
1
3
5
7
10
O
0.1
0.2
0.3
0.4
0.5
mg/L

Residues in Runoff Water

- During decision-making process registrants indicated an area where movement to ground water may be in rain runoff from groves
- Runoff collected in structures that inject water into subsurface soil
- Soil prone to runoff because infiltration rates low due to combination of hardpan layer and repeated use of pre-emergence herbicides
- Study conducted in cooperation with Tulare CAC staff to collect runoff from citrus and analyze

Hardpan soils

Low infiltration rates due to combination of

- hardpan presence
- annual applications
- vehicle traffic

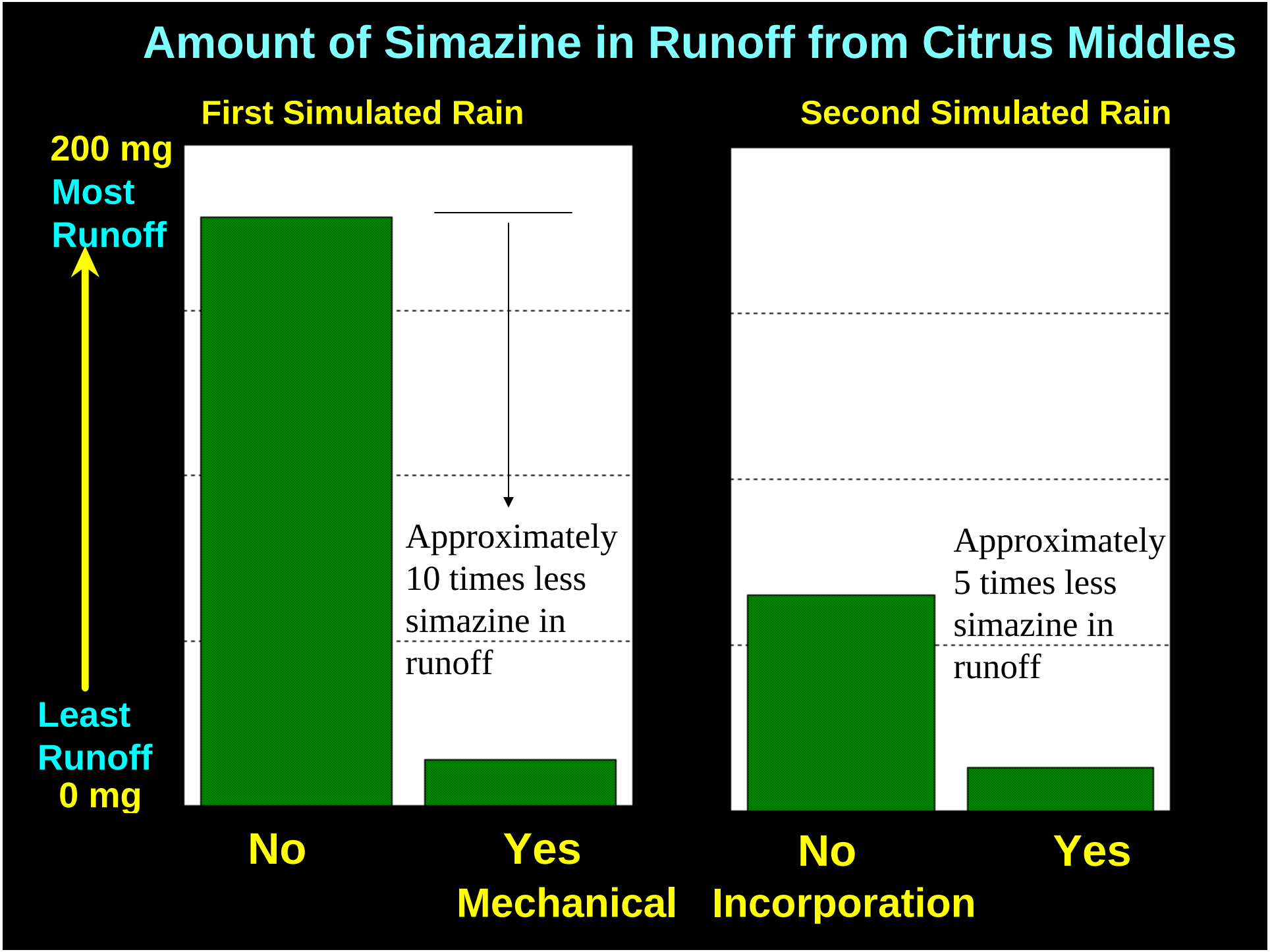
so to avoid flooding winter rain runoff is directed and injected into bore holes called ‘ Dry Wells’

Other pathways present – drainage ditches

Simazine and Diuron Concentration in Rain Runoff Water

Application	Sampling Interval	Concentration in Runoff	
		Simazine	Diuron
	(Months)	(µg/L)	(µg/L)
Simazine + Diuron	1	65	418
	2	450	100
	2	535	159
	2	934	891
	2-1/2	280	139
Simazine	2-1/2	1,130	6

Amount of Simazine in Runoff from Citrus Middles



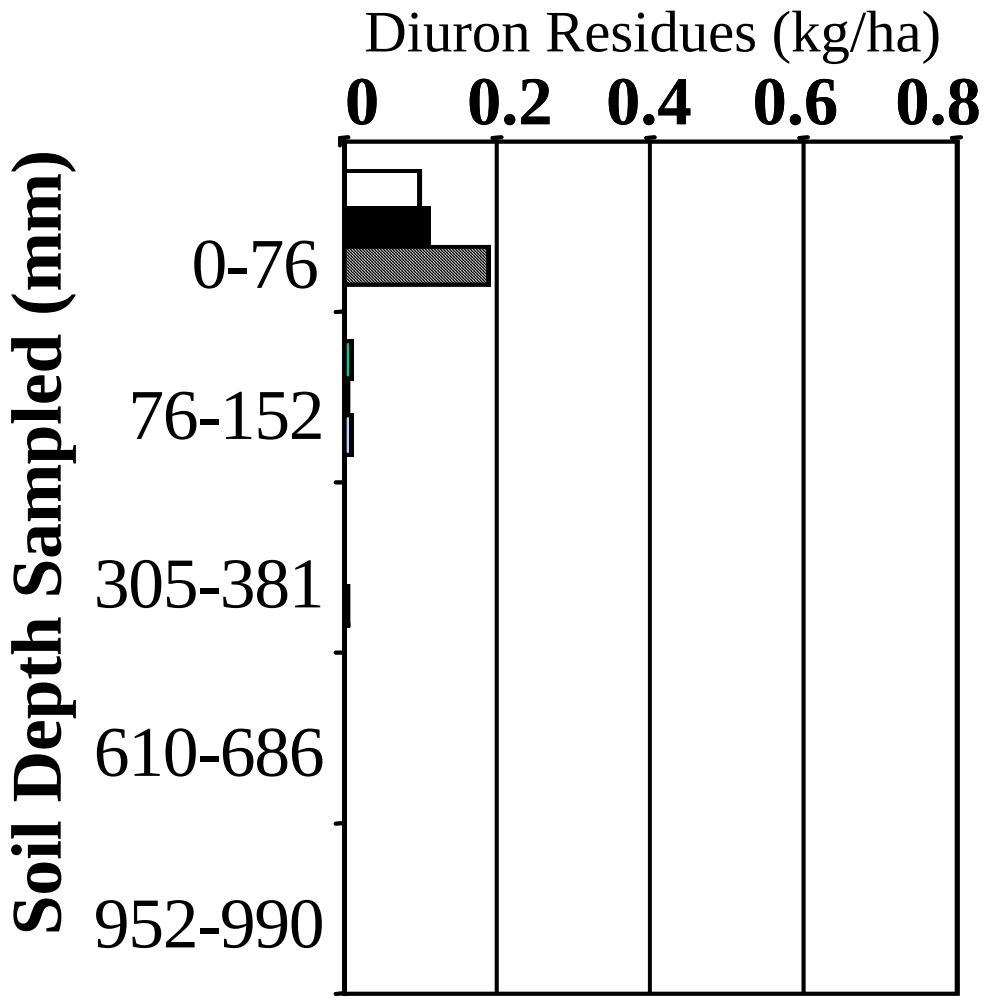
Other Processes?

Cracking-clay Soils with Water Table

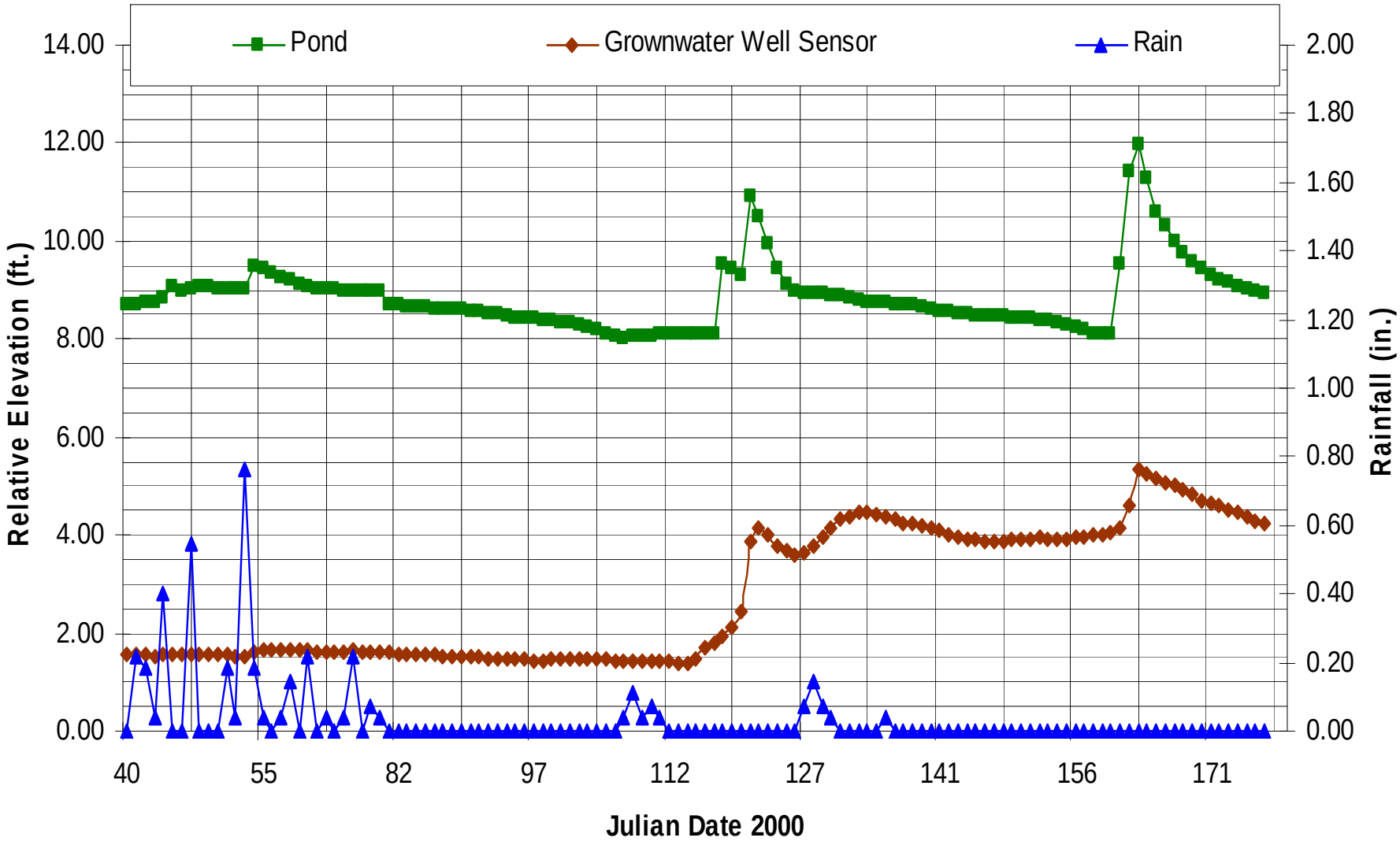
- Atrazine, Diuron, Hexazinone detections near Tracy
- Rotation of alfalfa with row crops and corn
- Hexazinone only used on alfalfa
- Soils are a cracking-clay but most fields with small ponds
- Cooperative study with San Joaquin Farm Advisors, grower, and CAC

Leaching or runoff ?

Soil sampled 6 months after application with residues exposed to winter rainfall and 2 border-check irrigations. Residues retained near surface



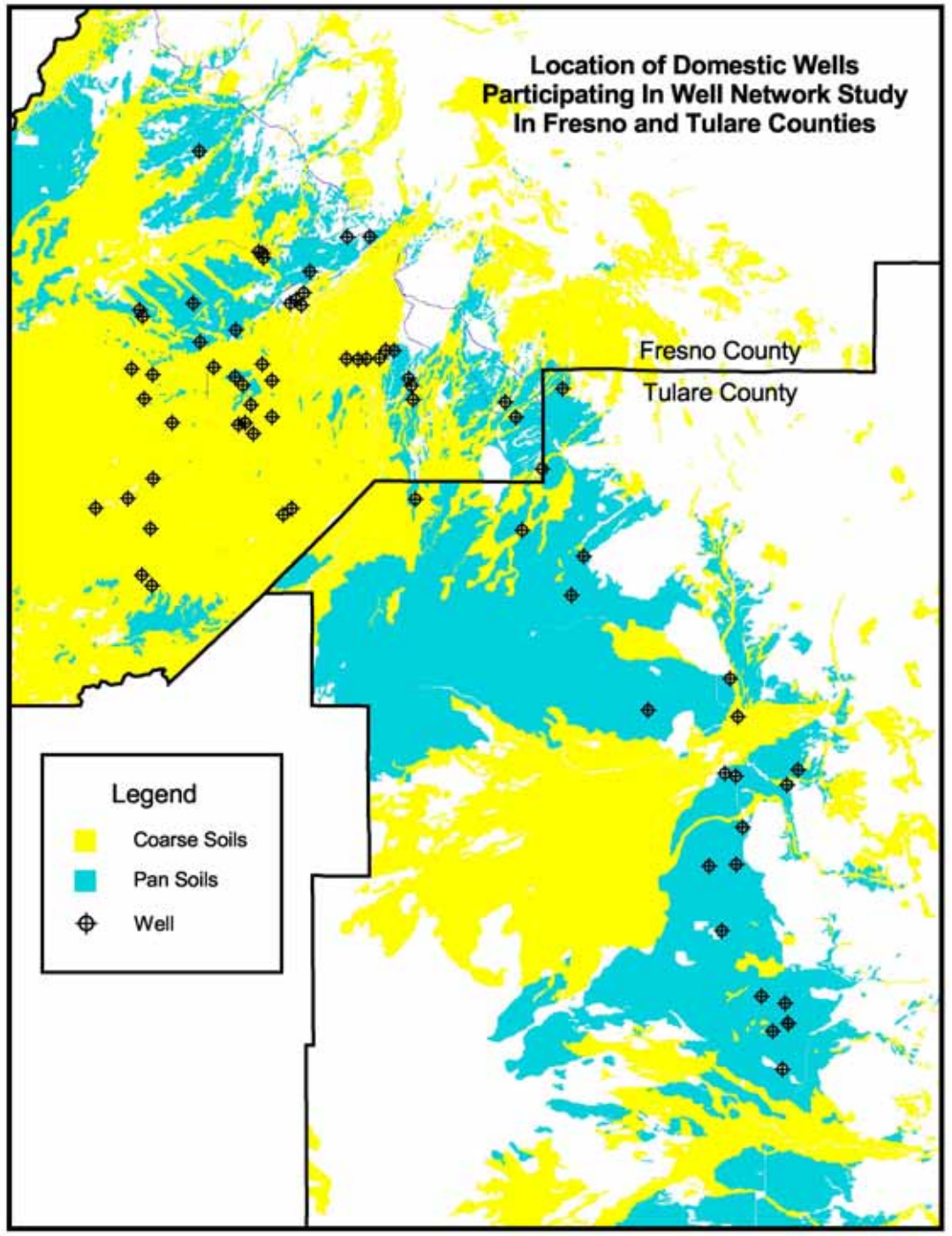
Relative Pond and Ground Water Elevation
Grownd Water Sensor Elevation = 0 FT



Effectiveness of Mitigation

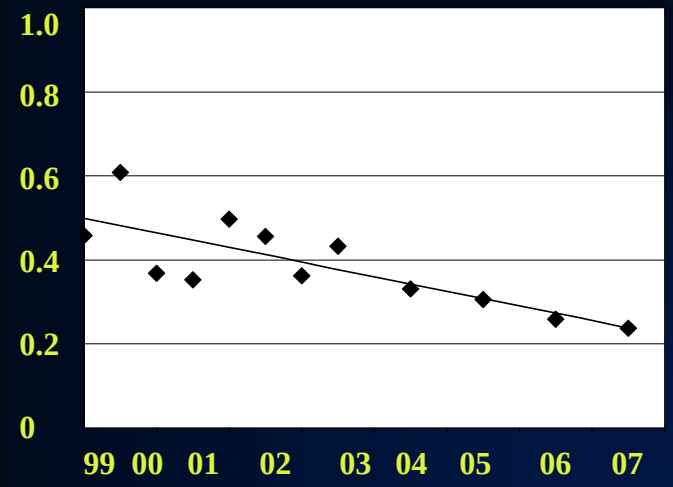
- Direct measure is decreases in pesticide concentrations in wells
- Established a domestic well monitoring network
  - Voluntary
  - Wells previously contained residues
  - Long-term commitment

Well network Located in leaching and runoff GWPAs in Fresno and Tulare Counties

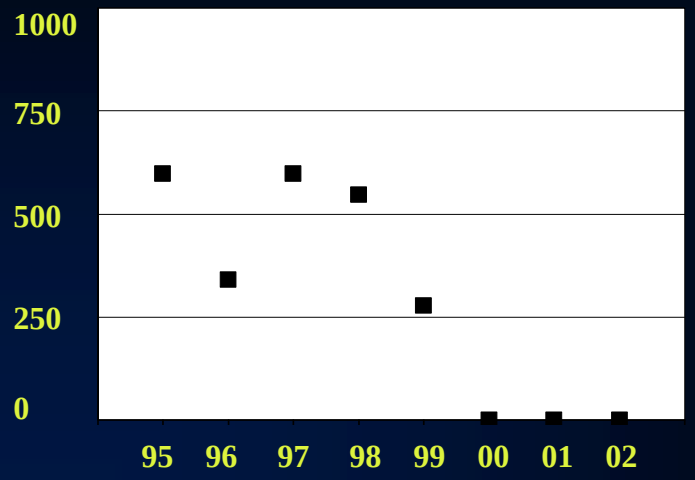


Diuron (ug/L) PMZ Established 1999

Concentration in Well Water (ug/L)

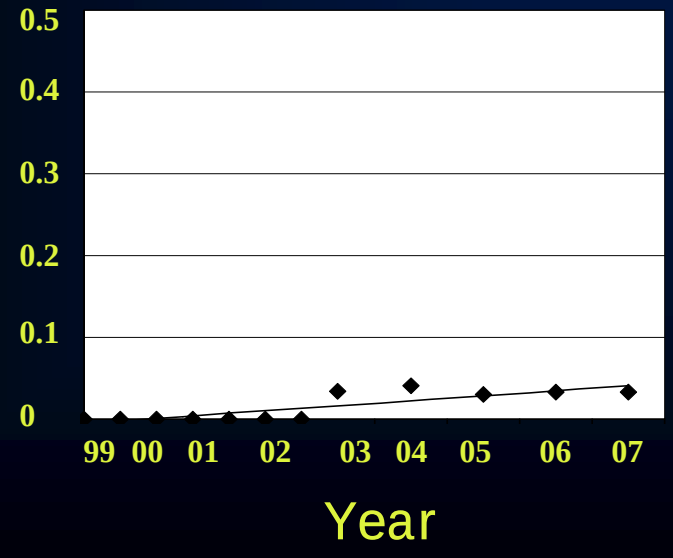


Lbs of Use in Section

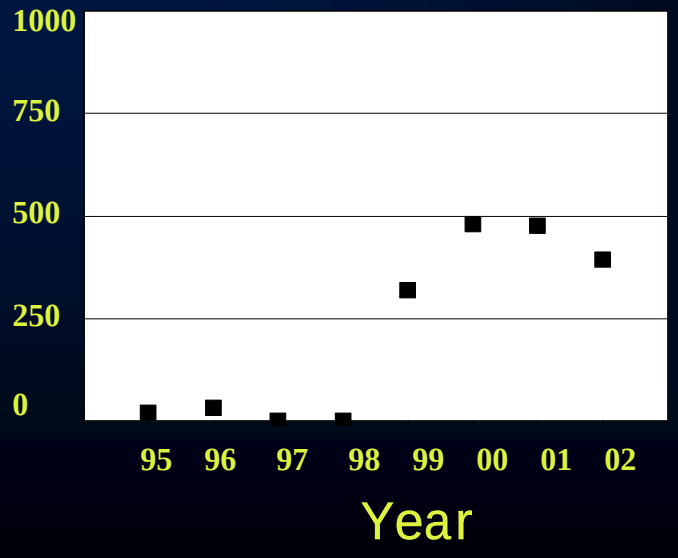


Norflurazon (ug/L)

Concentration in Well Water (ug/L)



Lbs of Use in Section



Summary

- CALVUL provides regional approach – contiguous areas of land identified with similar geographical properties that reflect vulnerable condition.
- Facilitates site specific action – mitigation measures based on pathway to ground water, which are based on major soil feature.
- Menu of mitigation options – 5 options in Leaching and 9 options in Runoff GWPA.
- CALVUL is open-ended – additional data layers can be added to refine spatial identification.